MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2016/2017

EME2036 – MANUFACTURING AND OPERATIONS MANAGEMENT

(ME, RE)

31 MAY 2017
9.00 a.m – 11.00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of **10** pages with **4** Questions and Appendices only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the answer booklet provided.

Question 1

Table Q1a

Quarter	Year 2014	Year 2015	Year 2016
1	105,000	112,000	115,000
2	90,000	87,000	85,000
3	77,000	75,000	73,000
4	135,000	140,000	141,000

(a) The Parisian Pastry House is famous for its French macarons. **Table Q1a** shows the numbers of macarons sold quarterly within the recent three years. By using the multiplicative seasonal method, determine

i. Average demand of macarons for the past three years. **[3 marks]**

ii. The seasonal factor for each quarter of year 2017. **[6 marks]**

iii. The total demand of macarons for year 2017 is expected to be increased by 50% of the total macarons sold in year 2016. Forecast the number of macarons to be sold for each quarter in year 2017. **[6 marks]**

(b) The Concept Hair Salon offers Package **A**: cut + wash/blow, and Package **B**: perm/colour + cut + wash/blow options for its customers. **Figure Q1b** shows the process flow diagram of both packages. The hair salon accepts both reservations and walk-in customers.

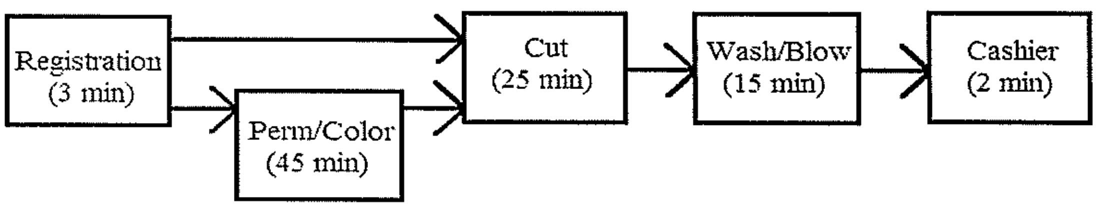

Figure Q1b

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i. A customer has made reservation at 3:00pm. Upon arrival, she registered for Package **B**. At the same time, another walk-in customer visits the hair salon and registers for Package **A**. Assume there is only one hairstylist available at that time. How long does the walk-in customer have to wait before his turn comes? Suggest if he should wait or make a reservation to visit the hair salon in the next time, and state the reason. **[3 marks]**

ii. Which single activity is the bottleneck for the entire process of Package **A** and Package **B**, respectively? **[2 marks]**

iii. What is the capacity (customers served per hour) of the bottleneck for both Package **A** and Package **B**? **[2 marks]**

iv. Assume there is only one hairstylist available and the hair salon opens from 10:00am till 7:00pm daily, how many customers can the hairstylist serve in one day if all the customers registered for Package **A**? If all the customers registered for Package **B**? Give suggestion on how the hairstylist can improve the service provided. **[3 marks]**

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Question 2

(a) The inventory turnover of a product is 15 turns per year and its weekly sales at cost is RM 58,750.00.

i. The definition of the inventory turnover. **[2 marks]**

ii. Determine the average aggregate inventory value and the weeks of supply. **[3 marks]**

(b) A garment factory has four jobs to be processed in its backlog. The time since the order was placed, processing time, and the promised due dates are stated in **Table Q2b**.

Table Q2b

Job	Time Since Order Arrived (days ago)	Processing Time (days)	Due Date (days from now)
A	13	4	19
B	27	5	18
C	16	11	15
D	9	8	22

i. Develop the schedule by using **EDD** rule. Calculate the average flow time and average days past due. **[4 marks]**

ii. Develop a separate schedule by using **SPT** rule and recalculate the average flow time and average days past due. **[4 marks]**

iii. Which rule gives the best schedule if the factory emphasized on punctuality? State the reason. **[2 marks]**

(c) Onienta Hospital emergency room is a serving the needs of the general public on first come, first served basis. There are **four** doctors available to treat patients. Patients arrive at the rate of **six** per hour, according to a Poisson distribution, and do not balk or renege. The average time required for a treatment time is 20 minutes, according to an exponential distribution.

i. What is the probability that no patients are in the room? **[6 marks]**

ii. What is the average number of patients waiting in the lobby? **[2 marks]**

iii. What is the average total time that a patient spends in the hospital? **[2 marks]**

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Question 3

(a) Tom's Cat Hotel operates 52 weeks per year, 6 days per week, and uses a continuous review inventory system. It purchases kitty litter for $11.70 per bag. The following information is available about these bags.

Demand = 60 bags/week

Order cost = $50/order

Annual holding cost = 27 percent of cost

Desired cycle-service level = 80 percent

Lead time = 3 weeks (18 working days)

Standard deviation of weekly demand = 15 bags

Current on-hand inventory is 220 bags, with no open orders or backorders.

i. What is the **EOQ**? What would be the average time between orders (in weeks)?

[6 marks]

ii. What should the reorder point be for litter? **[5 marks]**

iii. An inventory withdrawal of 10 bags was just made. Is it time to reorder?

[2 marks]

(b) **Figure Q3(b)** illustrates the bill of material for product **A**. The master production schedule start row in the master production schedule for product **A** calls for 50 units in week 2, week 6, week 8 and week 9. The inventory record data table is given in **Table Q3(a)** and the material requirements plan for item **C** is given in **Table Q3(b)**. Develop a material requirements plan for the next 8 weeks for item **F** and **G**.

[12 marks]

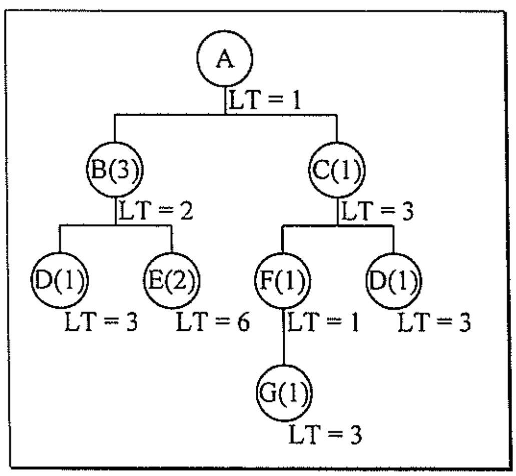

Figure Q3(a) Bill of material for product **A**

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Table Q3(a) Inventory record data

	Item					
Data Category	**B**	**C**	**D**	**E**	**F**	**G**
Lot-size rule	L4L	L4L	POQ ($P = 2$)	L4L	L4L	FOQ = 100
Lead time	2 weeks	3 weeks	3 weeks	6 weeks	1 week	3 weeks
Safety stock	30	10	0	0	0	0
Scheduled receipts	150 (wk 2)	50 (wk 2)	None	400 (wk 6)	40 (wk 3)	None
On-hand inventory	30	20	60	400	0	0

Table Q3(b) Material requirement planning for item C

Item: C

Description:

Lot Size: L4L
Lead Time: 3 weeks
Safety Stock: 10 units

Week		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Gross requirements			50				50		50	50	
Scheduled receipts			50								
Projected on hand	20	20	20	20	20	20	10	10	10	10	10
Planned receipts							40		50	50	
Planned order releases				40		50	50				

Question 4

(a) A product is manufactured in a company with eight set of activities. The activities are marked as **A** to **H**. The activities normal time, normal cost, crash time and crash cost are given in **Table Q4(a)**. The indirect cost involved in the manufacturing product per day is RM 625. The company has to pay a penalty per day if the product not delivered to its customer on 75th day. The penalty amount is RM250 per day.

Table Q4 (a) Product manufacturing activity data

Activity	Normal Time (days)	Normal Cost (RM)	Crash Time (days)	Crash Cost (RM)	Immediate Predecessors (s)
A	25	25,000	20	29,000	-
B	25	20,000	15	45,000	-
C	10	15,000	5	25,500	A, B
D	15	37,500	10	50,000	B
E	25	22,500	15	30,000	C, D
F	10	32,500	5	37,500	E
G	15	22,500	15	22,500	E
H	25	12,500	15	22,000	G

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i. Draw the activity on node network diagram for the above product manufacturing activity. **[3 marks]**

ii. Find the critical path and duration **[2 marks]**

iii. Tabulate the slack for all activities. **[2 marks]**

iv. Find the crash cost per day and maximum crash days for each activity. **[4 marks]**

v. Find the new critical path and total project cost for crashing activity **E** from 25 to 15 days. **[2 marks]**

vi. After above, again find the new critical path and total project cost for crashing activity **H** from 25 to 20 days. **[2 marks]**

(b) A chemical company's quality control manager checking the content quantity data of chemical filled bottles from a production line. The standard design value to the boltless is 100 ± 0.10 ml. A total of seven sample of 4 observations each is taken and the values are given in **Table Q4(b)**.

Table Q4 (b) Observed data

Sample number	Number of Observations			
	1	2	3	4
1	101.23	100.19	100.12	100.20
2	100.19	100.17	101.14	99.98
3	101.18	100.20	101.31	100.19
4	99.81	100.20	100.50	100.19
5	100.22	100.17	101.23	100.21
6	101.19	100.19	100.60	100.22
7	100.21	100.20	101.25	100.20

i. Calculate the process average and range. **[2 marks]**

ii. Calculate the control limits for mean and range. **[2 marks]**

iii. Draw the control charts for mean and range and plot the data **[4 marks]**

iv. Comment your observation on control charts. **[2 marks]**

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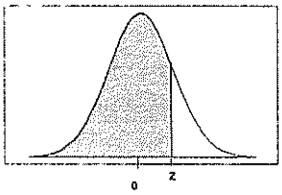
Appendix I

Standard Normal Cumulative Probability Table



Cumulative probabilities for POSITIVE z-values are in the following table:

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990

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Appendix Table 1 Factors for calculating three-sigma limits for the x-chart and R-chart

Size of Sample (n)	Factor for UCL and LCL for x-Chart (A_2)	Factor for LCL for R-Chart (D_3)	Factor for UCL for R-Chart (D_4)
2	1.880	0	3.267
3	1.023	0	2.575
4	0.729	0	2.282
5	0.577	0	2.115
6	0.483	0	2.004
7	0.419	0.076	1.924
8	0.373	0.136	1.864
9	0.337	0.184	1.816
10	0.308	0.223	1.777

$UCL_R = D_4\overline{R}$ $\qquad LCL_R = D_3\overline{R}$

$UCL_{\bar{X}} = \overline{\overline{x}} + A_2\overline{R}$ $\qquad LCL_{\bar{X}} = \overline{\overline{x}} - A_2\overline{R}$

Process capability:

$$C_{pk} = Minimum\ of\left[\frac{\overline{\overline{x}} - Lower\ specification}{3\sigma};\frac{Upper\ specification - \overline{\overline{x}}}{3\sigma}\right]$$

$$C_p = \left[\frac{Upper\ specification - Lower\ specificaation}{6\sigma}\right]$$

Waiting Line Models Equations:

$\rho = \frac{\lambda}{\mu}$ $\qquad \rho = \frac{\lambda}{s\mu}$ $\qquad \rho = 1 - P_o$

$P_n = (1-\rho)\rho^n$ $\qquad P_n = \begin{cases} \frac{(\lambda/\mu)^n}{n!}P_0 & 0 < n < s \\ \frac{(\lambda/\mu)^n}{s!s^{n-s}}P_0 & n \geq s \end{cases}$

$P_0 = (1-\rho)$ $\qquad P_0 = \left[\sum_{n=0}^{s-1}\frac{(\lambda/\mu)^n}{n!} + \frac{(\lambda/\mu)^s}{s!}\left(\frac{1}{1-\rho}\right)\right]^{-1}$ $\qquad P_0 = \left[\sum_{n=0}^{N}\frac{N!}{(N-n)!}\left(\frac{\lambda}{\mu}\right)^n\right]^{-1}$

$L = \frac{\lambda}{\mu - \lambda}$ $\qquad L = \lambda W$ $\qquad L = N - \frac{\mu}{\lambda}(1-P_0)$

$L_q = \rho L$ $\qquad L_q = \frac{P_0(\lambda/\mu)^s\rho}{s!(1-\rho)^2}$ $\qquad L_q = N - \frac{\lambda+\mu}{\lambda}(1-P_0)$

$W = \frac{1}{\mu - \lambda}$ $\qquad W = W_q + \frac{1}{\mu}$ $\qquad W = L[(N-L)\lambda]^{-1}$

$W_q = \rho W$ $\qquad W_q = \frac{L_q}{\lambda}$ $\qquad W_q = L_q[(N-L)\lambda]^{-1}$

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Managing Inventories

$C = \frac{Q}{2}(H) + \frac{D}{Q}(S)$ EOQ = $\sqrt{\frac{2DS}{H}}$ $\text{TBO}_{\text{EOQ}} = \frac{EOQ}{D}(52 \text{ weeks/year})$

IP = OH + SR – BO R = $\bar{d}$ L + Safety stock Safety stock = $z\sigma_{dLT}$

$\sigma_{dLT} = \sigma_d \sqrt{L}$ $I_{\max} = Q\left(\frac{p-d}{p}\right)$ $C = \frac{Q}{2}\left(\frac{p-d}{p}\right)(H) + \frac{D}{Q}(S)$

ELS = $\sqrt{\frac{2DS}{H}}\sqrt{\frac{p}{p-d}}$ $\text{TBO}_{\text{ELS}} = \frac{ELS}{D}$

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